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#### Background

The genus *Nepenthes* includes a number of species which are highly endangered because of habitat destruction, fire and collection pressures. Probably no other *Nepenthes* species is as endangered as *Nepenthes clipeata*. First described by Danser (1928), *Nepenthes clipeata* is only known from the vertical cliff faces of Gunung Kelam, in Kalimantan Barat (Clarke, 1997). Explorations of the surrounding mountains have failed to find additional populations (Chien Lee, pers. comm.).

#### Habitat Stresses

Despite its great rarity, *Nepenthes clipeata* does not grow in any sort of national park or forest reserve.

Prior to 1980, population stresses due to field collection were not significant because few people visited the remote cliff faces of Gunung Kelam. Subsequently, collectors began to visit the mountain frequently and collect large numbers of plants through the 1980s. Local guides, enlisted by tourists, became impressed by the plants and harvested specimens for their villages near the foot of the mountain (Robert Cantley, pers. comm.; Chien Lee, pers. comm.). Such plants rapidly perished and were replaced by new, freshly gathered specimens. Despite these significant pressures, populations of this plant were small but stable as recently as 1990 (Clarke, 1997). No plants were observed during a search for the species in 1993 (J.-P. De Witte, pers. comm.). Simpson (1995) reported that M. Jebb estimated that as few as 15 plants may have remained in the wild by that date.

Conditions have changed within the last decade. Drought conditions in 1997-1998 resulted in significant plant mortality. A new season of drought began early in 2000. Interest in this plant by collectors has increased. The CITES protection status of *Nepenthes clipeata* will be recommended to be upgraded from Appendix II to Appendix I by the CPSG (Carnivorous Plant Specialist Group, of the IUCN's Species Survival Commission). If this is done, it is unclear how this change in status will affect the wild populations of plants. (It is possible it may drive the legal trade of artificially cultivated plants underground, encouraging black market sales and other illegal activities.)

#### In situ Population Viability

The combination of threats from drought, fire, and collection by visitors and native people is so severe that the plant is likely to become extinct in the wild within 10-20 years (Chien Lee, pers. comm.). In situ conservation, always the preferred option, appears to be unrealistic and unworkable because the single known location for this plant is not likely to be a viable habitat in the long term—repeated burning has caused major community changes to the mountain flora, and these burns are likely to continue. In situ conservation would only be viable if these anthropogenic changes were to stop and the native mountain community was to be restored. There is no governmental interest or financial mechanism for this to happen, so it is likely the mountain sites for *Nepenthes clipeata* will continue to degrade.

In broad terms, *Nepenthes clipeata* specimens in cultivation fall into categories of “white market” and “black market.”

White market plants include those that have been legally collected by botanical gardens, or by carnivorous plant horticulturists who usually are interested in introducing plants into in vitro cultivation for rapid propagation. (Note: the in vitro cultivation methods used for *Nepenthes clipeata* is not tissue culture in the usual sense, because tissue culture strictly refers to maintaining a culture of undifferentiated cells and in vitro propagation refers to production of whole plants from cell cultures derived from explants—generally seeds.). White market plants have been collected both as live plants and as seed. Two main categories of white market plants exist:

1)Plants that were collected as live plants or cuttings. While it is difficult to introduce live *Nepenthes* plants into sterile in vitro culture, it is possible.

2)Plants that originated in cultivation. Supposedly, both male and female plants are in cultivation at Munich Botanical Gardens and perhaps elsewhere, and cross-pollination between these plants has occurred on at least one occasion. (The first plants were placed into in vitro culture from Munich seeds in the spring of 1997 (Wistuba, 1998). These plants are now approaching maturity.) However, it is possible that the cross-pollination may have been compromised by pollen from other *Nepenthes* species in the Munich collection, and the genetic purity of the progeny should be viewed cautiously. (*Nepenthes clipeata* is quite distinct morphologically, so fortunately most hybrids should be easily detectable once the plants have matured.) Other fortuitous flowering events will inevitably occur in the future, and such opportunities must be carefully exploited.

It is unknown how many genetically distinct lines of white market plants exist in cultivation, but estimates place the number at three to four (Andreas Wistuba, pers. comm.). Both male and female plants have been grown at the Munich Botanical Gardens in the past.

Black market plants include those that may have been collected illegally and without appropriate export/import documents. It is unknown how many genetically distinct black market plants are presently in cultivation. Some of the apparently white market plants in cultivation may have had their origins as black market plants.

### *Nepenthes clipeata* Survival Project Objectives

It appears that the long-term viability of wild populations of *Nepenthes clipeata* is low. Therefore, it is imperative that ex situ conservation measures be implemented. The *Nepenthes clipeata* Survival Project (NcSP), under the auspices of The International Carnivorous Plant Society, has been devised to maximize the genetic diversity of this species in cultivation.

This document will outline the general intentions of NcSP and its proposed actions.

### Short Term Actions

1)Develop a database to track all known *Nepenthes clipeata* strains. Produce and distribute a questionnaire to populate this database with tracking information on as many clones of *Nepenthes clipeata* as possible. Growers in this database will be considered part of a *Nepenthes clipeata* “network”.

2)Publicize the issues surrounding the threats to *Nepenthes clipeata*, and how NcSP activities are designed to abate these threats. These articles should be published in as many hobbyist venues as possible, including at least five newsletters and journals, and at least four major web sites.

3)Make in vitro *Nepenthes clipeata* plants easily available worldwide by publicizing sources of legal, ethically obtained and propagated material. While this publicity may increase collector interest in the plant, as long as prices are sufficiently low and supply is sufficiently high, the actions overall should reduce collection pressures. This information should be published in as many hobbyist venues as possible, including at least five newsletters and journals.



Figure 1: Young *Nepenthes clipeata* in *Sphagnum*, the typical growth habit for smaller plants. Notice the unique nature of the tendril attachment to the leaves. Image provided to the ICPS for use by the NcSP, courtesy of Chien Lee.



Figure 2: Mature *Nepenthes clipeata* on Gunung Kelam. Image provided to the ICPS for use by the NcSP, courtesy of Chien Lee.



Figure 3: Mature *Nepenthes clipeata* plants damaged by collectors. Image provided to the ICPS for use by the NcSP, courtesy of Chien Lee.



and at least four major web sites.

4) Develop and widely publish articles on the following aspects of *Nepenthes clipeata* cultivation: Proper cultivation of in vitro and mature plants; collecting/storing pollen, and pollinating *Nepenthes*; collecting and storing seed; how to distinguish pure *Nepenthes clipeata* from its various hybrids; merits of pure *Nepenthes clipeata* vs. hybrids. This information should be published in as many hobbyist venues as possible, including at least five newsletters and journals, and at least four major web sites.

5) Establish a network to store and distribute *Nepenthes clipeata* pollen and/or seed produced. The network should include strains of at least 75% of the plants included in the tracking database.

6) Encourage growers of larger plants to exchange cuttings so adult plants of different clones can be housed together and hopefully increase chances of concurrent flowering. Members of the *Nepenthes clipeata* growers network can be given advice on how to apply for appropriate CITES paperwork to best participate in this program. If appropriate and if in the interest of the success of the overall program, the NcSP will help defray the costs of CITES paperwork.

7) If appropriate, develop and formalize relationships between the NcSP and organizations such as the International Carnivorous Plant Society (ICPS) or the IUCN (especially the Carnivorous Plant Specialist Group).

8) A budget showing expenses and reimbursements should be developed for the NcSP.

#### Medium Term Actions

1) There are currently no plans to engage in plants of dubious origin. However, The NcSP will remain open to the possibility of accessioning into its databases information about such plants. Similarly, plant stock with dubious origins may be incorporated into NcSP plans if a protocol can be devised that is satisfactory to the NcSP, as well as related conservation groups. If this issue becomes too divisive or problematical, and unnecessarily risks the success of the NcSP, actions relating to it will probably be postponed.

2) Future collections from the wild are probably unjustified. If, however, additional material were collected, only seeds should be removed.

3) Initiate contacting local governing bodies in Kalimantan Barat. While visitation to Gunung Kelam remains low, maintaining some level of vigilance on activities in the area, through communication with locals, would be helpful.

4) Investigate if other plants in the area of Kalimantan Barat are endangered and what efforts are underway to support their conservation. Joint proposals should be sought with such groups.

5) It may be useful to place tissue samples from identified pure or hybrid strains of *N. clipeata* plant into DNA preservatives (ultracold storage, DMS, 100% ethanol, etc.) as a basis for future studies.

6) Identify organizations such as botanical gardens, horticultural societies, and conservation organizations that would be willing to cooperate with the NcSP. Investigate sources of funding for these initiatives. Ron Gagliardo (Atlanta Botanical Gardens), Ruth Kiew (Singapore), Kath King (Kew) might be appropriate initial contacts.

7) Make arrangements for the storage of pollen and fertilized seeds in cryogenic storage. Seeds are to be deposited with the understanding that a set number of seeds can be removed by the project at anytime and that the storage facility will notify the project at least 3 months in advance if they are no longer able to care for the storage of the seeds. Agreements to be established for 50 or 100 years. At least two facilities should be sought on different continents (likely to be USA, Europe, and possibly Japan). Arrangements have already been established for receipt of seeds and pollen and temporary storage (at -80°C) at Texas Tech University, Lubbock, Texas (via James Cokendolpher) until other arrangements for long-term storage have been made.

#### Long Term Actions

1) Reintroduction plans could be developed and implemented. A useful starting point for this kind of difficult, expensive, and risky project would be the work of Veena Tandan (Department

of Zoology, North Eastern Hill University, Shillong 793022, Meghalaya) (Akula, 1996). Professor Katsuhiko Kondo (Japan) has worked with a somewhat similar project, involving *Aldrovanda vesiculosa* in Japan, and could be a good resource in this kind of project.

2) Identify individuals that could conduct research if funding were available which could contribute to the survival of this and other *Nepenthes* species. Further, assist these individuals in locating funds for such projects. Examples of such projects might be:

- i) Investigate karyology for determining sexes of young plants
- ii) Factors influencing blooming
- iii) Factors influencing apomixis
- iv) Method for preparing meristem tissue culture
- v) Effects of long-term cryogenic storage on pollen and fertilized seed
- vi) Establish protocol for DNA testing for culling hybrids from breeding program and establish limits of populations
- vii) Investigations on minimal numbers of unrelated plants needed for survival in wild
- viii) Investigate population viability of *Nepenthes clipeata*—determine minimum number of plants needed to ensure long term viability.

### Measures of Success

To determine if NcSP is reaching its goals, the following timetable is proposed for the next two years.

1) By March 2004: Develop database for tracking clones and larger plants of *N. clipeata* in culture.

2) By June 2004: Make arrangements with at least 2 (one in USA, one in Europe) cryogenic storage facilities to store fertilized seeds and pollen.

3) By June 2004: Submit for publication (on WWW and all major carnivorous plant society newsletters/journals) notices of the database and project activities requesting help/data.

4) By September 2004: Prepare web pages on cultivation and propagation.

5) By January 2005: Establish at least 5 distinct clones of *N. clipeata* in at least 6 different botanical gardens (2 in USA, 2 in Europe, 2 in Australasia).

### Financial Support and Future Programs

At present, NcSP activities are being supported by the volunteer work of the NcSP founding members. In the future, financial support will be required to pay for its activities.

1) Some funds to support the NcSP can be provided by the ICPS conservation fund. This discretionary fund is managed by the ICPS Director of Conservation.

2) Future corporate or private support may be sought for the NcSP.

3) Nurseries may be encouraged to contribute an as-yet undetermined amount per *Nepenthes clipeata* plant sold.

The NcSP is a pilot program. If it is successful (as shown by its measures of success), additional, similar programs may be launched.

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